THE GOLD STANDARD DIAGNOSIS FOR BENIGN PAROXYSMAL POSITIONAL VERTIGO

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ABSTRACT

Objectives. The purpose of this paper is to improve quality of care for posterior canal BPPV patients by making an accurate and efficient diagnosis and by decreasing the inappropriate use of expensive tests such as radiographic imaging and vestibular testing.

Method and materials. The study was conducted in our clinic on a group of 82 BPPV patients over an eleven months time frame between January 2011 and November 2011. The Dix-Hallpike maneuver was applied to each patient. Results were statistically analyzed with the program Microsoft Excel 2003.

Results. Out of the 82 patients 90% were diagnosed with posterior canal BPPV by performing the Dix-Hallpike maneuver, another 9% of the patients had horizontal canal BPPV and only 1% had superior canal BPPV. 76 patients were found in stable condition at the follow-up control one week after the repositioning maneuvers. This demonstrates a 92,6% rate of success of this treatment following a correct diagnosis.

Conclusions. The Dix-Hallpike maneuver represents the "gold standard" diagnosis for posterior canal BPPV. Therefore, the use of expensive investigation such as computerized tomography and magnetic resonance imaging can be limited and the time for establishing the diagnosis for BPPV patients can be reduced, allowing a quicker treatment of this condition.

Key words: vertigo, Dix-Hallpike maneuver, semicircular canals, nystagmus, otoconia

Abreviations:
BPPV = Benign Paroxystic Pozitional Vertigo, DHI = Dizziness Handicap Inventory, PSC = posterior semicircular canal, HSC = horizontal semicircular canal, SSC = superior semicircular canal, CT = computerized tomography, MRI = magnetic resonance imaging

GENERALITIES

Vertigo is the feeling of spinning or falling where is no motion. During vertigo episodes it may be difficult to focus visually and many people find it uncomfortable to keep their eyes open. Sweating, lightheadness, nausea and vomiting are also common. Vertigo can last from a few minutes to several days, depending on it's generating factors.

DEFINITION

BPPV is the most frequent form of vertigo and consists of recurrent, less than one minute long episodes of vertigo which are related to changes in head position with respect to gravity (such movements like getting out of bed or rolling over in bed, looking up (eg. to place an object on a shelf) or bending forward (eg. to tie shoes). Patients are asymptomatic or report subjective imbalance in between vertigo episodes.

EPIDEMIOLOGY

Women are affected twice as often as men (in our study 58 patients were females and 24 patients were males) and the age of onset is between the fifth and seventh decades of life. Often no cause is ever detected or whiplash, head injury, stapes surgery, labyrinthitis may be implicated in etiology of

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the disease. Incidence is growing with the age therefore age-related degeneration could be considered.

Although BPPV is the number one form of vertigo, it requires about 4,5 physician visits before it is correctly diagnosed. Following correct diagnosis BPPV patients enjoy an almost 95% successful treatment rate.

OVERVIEW OF THE ANATOMY AND PHYSIOLOGY OF THE SEMICIRCULAR CANALS

In the inner ear, the three semicircular canals (PSC, SSC, HSC) are placed at right angles to each other, allowing for an assessment of the body's angular acceleration through space.

The vestibular receptors are placed in the crista – a structure found in the ampulla. Ampulla is the dilated end of the semicircular canals. There are 5 ampullas, because the posterior and superior canals have a common end in the utricule. The endolymphatic fluid present within the membranous part of the canals is the subject to move as the head is turned. The receptors' cilias are embedded in a gelatinous substance found above the crista, known as the cupulla (Fig. 1). When the head turns in the same plane as the semicircular canal, the inherent inertia results in a flow of the endolymph in the direction opposite to the head movement. This flow in turn moves the cupulla and the ampullary nerve is stimulated.

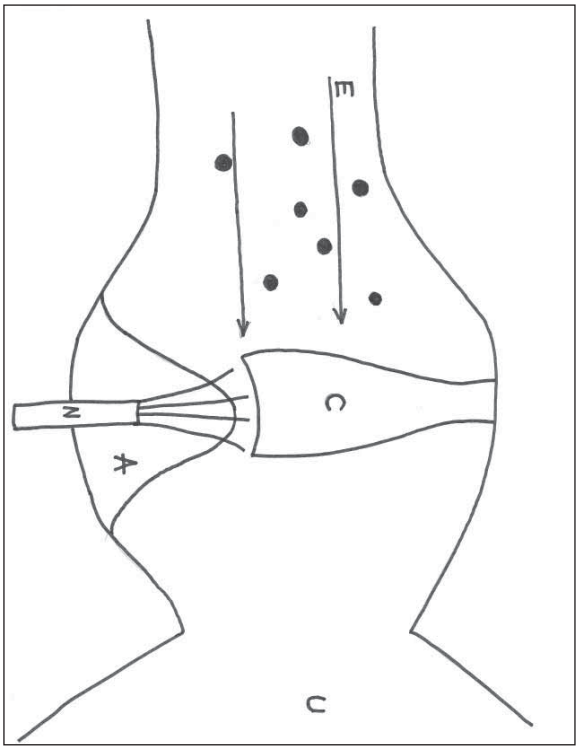

FIGURE 1. *Ampulla (A – crista ampullaris, C – cupulla, N – ampullary nerve, E – endolymphatic flow)*

PATHOLOGY

Two theories are considered when discussing BPPV.

The first theory is called the canalolithiasis theory, which states that free particles are found within the endolymph of the semicircular canals (Fig. 2). These particles are consider to be otoconial debris released from the utricle (while the saccule contains also otoconia, they are not able to migrate into the canal system). The otoconia usually migrate into the most dependent area of the labyrinth which is PSC. SSC is occasionally involved and HSC extremely rarely. These otoconias stimulate flow of the endolymph therefore exciting the vestibular receptors of the ampulla.

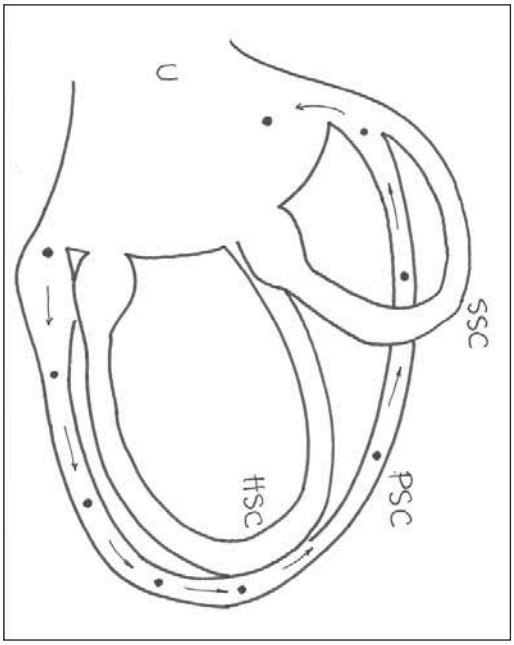

FIGURE 2. *Semicircular canals (U – utricule, PSC – posterior semicircular canal, HSC – horizontal semicircular canal, SSC – superior semicircular canal)*

The second theory is the cupulolithiasis theory which states that the particles are not free floating in the canal, but lying in a clump on the cupulla. This fact exerts a gravitational force on the cupulla, stimulating the vestibular receptors and producing a sensation of movement.

DIAGNOSIS

We will discuss the diagnostic of BPPV of the PSC because PSC is involved in more than 90% of

cases (in our study 74 from our patients had posterior canal BPPV, 7 had horizontal canal BPPV and only 1 had superior semicircular BPPV – Fig. 3). The diagnostic "gold standard" for the posterior canal BPPV has been the DIX – HALLPIKE MANEUVER for nearly 50 years. Although this maneuver has been well published over the years, however, lately, the poor biomechanics of this maneuver, both for the patient and clinicians performing it, have been reevaluated.

PERFORMING THE DIX-HALLPIKE MANEUVER

The Dix-Hallpike maneuver represents the moving of the patient through a set of specific head – positioning maneuvers to elicit the expected characteristic nystagmus of PSC.

This nystagmus typically displays several major characteristics:

Latency: there is a latency period between the completion of the Dix-Hallpike maneuver and the onset of subjective rotational vertigo and the objective nystagmus placed in the range between 5 and 20 seconds;

Up-Beating – Torsional: the fast component of nystagmus has a characteristic mixed torsional and vertical movement, with the upper pole of the eye beating towards the dependent ear and the vertical component beating towards the forehead (Fig. 4);

Crescendo-descrescendo: the rate of nystagmus begins gently, increased in intensity and then declines in intensity as it resolves within a period of 60 seconds from the onset of the nystagmus

Reversed direction after he patient returns to the upright head position;

Fatigability: the nystagmus typically reduces its severity when the maneuver is repeated. However, repeated performance of the Dix-Hallpike maneuver in order to demonstrate its fatigability is not recommended because repeated symptoms of vertigo may be discomforting and may interfere with the immediate treatment of BPPV.

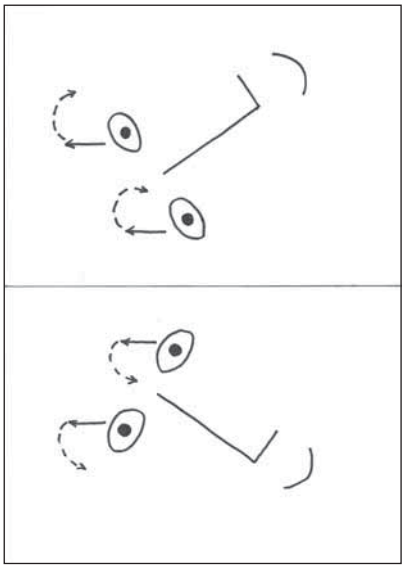

FIGURE 4. *Torsional nystagmus in Dix-Hallpike maneuver*

The clinician should mention to the patient that the upcoming movements could provoke a sudden onset of intense subjective vertigo, possibly accompanied by nausea, which will stop within 60 seconds. At the same time, the patient must be instructed to keep the eyes open during the entire maneuver.

The patient should be oriented so that, in the supine position, the head can "hang" with support off the posterior edge of the examination table by about 20 degrees. The examiner must be sure that he could support the patient's head and guide the patient through the maneuver safely and securely.

The maneuver begins with the patient in the upright-seated position with the examiner standing at the patient's side. The patient's eyeglasses should be removed if they are present. In the following paragraphs we will describe the maneuver to test the right ear.

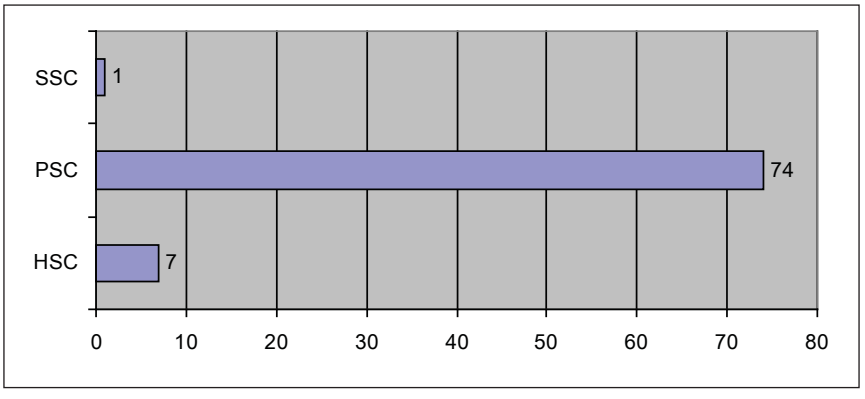

FIGURE 3. *Distribution by the affected semicircular canal*

The examiner rotates the patient's head 45 degrees to the right and, with manual support, maintains the 45-degree head turn to the right during the next part of the maneuver.

Next, the examiner quickly moves the patient to the supine right-ear down position and then extends the patient's neck slightly (approximately 20 degrees below the horizontal plane) so that the patient's chin is pointed slightly upward, with the head hanging off the edge of the examining table and supported by the examiner (Fig. 5). The examiner observes the latency, duration, and direction of the nystagmus. The provoked nystagmus in posterior canal BPPV is classically described as a mixed torsional and vertical movement with the upper pole of the eye beating toward the dependent ear (in this case the right ear). The patient must mention if there is any subjective vertigo.

After resolution of the subjective vertigo and the nystagmus the patient may be slowly returned to the upright position. During the return to the upright position, a reversal of the nystagmus may be observed and should be allowed to resolve.

The test continues with the examination of the left ear. The Dix-Hallpike maneuver (steps 1-4) should be repeated for the left side, with the left ear arriving at the dependent position. Again, the examiner should inquire about subjective vertigo and identify objective nystagmus, when present.

The Dix-Hallpike maneuver is the most common diagnostic criterion required for entry into clinical trials and for inclusion of such trials in meta-analyses. The lack of an alternative external "gold standard" diagnosis to the Dix-Hallpike maneuver limits the availability of rigorous sensitivity and specificity data. Although it is considered the "gold standard" test for posterior canal BPPV diagnosis, its accuracy may differ between specialty and non-specialty clinicians. Therefore, a negative Dix-Hallpike maneuver does not necessarily rule out a diagnosis of posterior canal BPPV. Because of the lower negative predictive values of the Dix-Hallpike maneuver, it has been suggested that this maneuver may need to be repeated at a separate visit to confirm the diagnosis and avoid a false-negative results.

The diagnostic accuracy of the Dix-Hallpike maneuver can be affected by several factors such as the speed of movements during the test, time of day, and the angle of the plane of the occiput during the maneuver. The Dix-Hallpike test must be done bilaterally to determine which ear is involved or if both ears are involved. In a small percent of cases, the Dix-Hallpike maneuver may be bilaterally positive (the specific nystagmus appears for each ear in the dependent position). For example, bilateral posterior canal BPPV is more likely to be encountered after head trauma.

Although the Dix-Hallpike maneuver is an important test to confirm the diagnosis of posterior canal BPPV, it should be avoided in certain circumstances.

Clinicians should consider the risk of stroke or vascular injury in patients with significant vascular disease, although there are no documented reports of vertebrobasilar insufficiency provoked by performing the Dix-Hallpike maneuver. Prior to place any patient in a head hanging or modified head hanging position, some authors strongly recommend that clinicians perform a Vertebral Artery Test on the patient to ensure that there is not any vertebral compression of the artery. The possibility

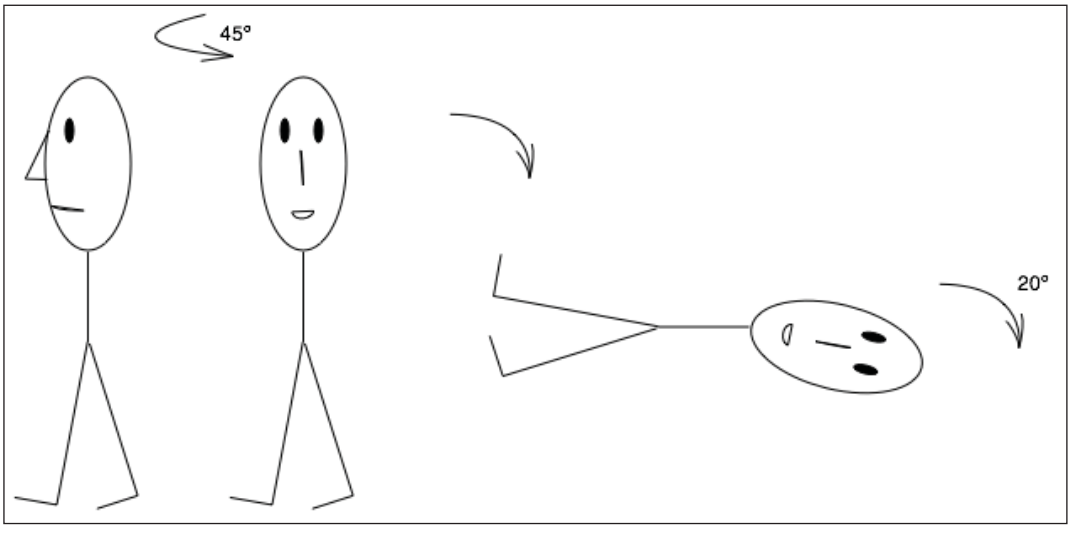

FIGURE 5. *The Dix-Hallpike maneuver*

of a patient experiencing a basilar arterial stroke should not be taken lightly. This is a simple test, which is referenced. The Hallpike Positioning Maneuvers may be performed once the Vertebral Artery Test has proved negative.

Vertebral Artery Test: In the Vertebral Artery Test, the patient, while in a sitting or supine position (preferably sitting), will push their head forward, turn their head comfortably to one side and pitch their head back. Positive findings for vertebral compression may include persistent dizziness, double-vision (diplopia), nausea or slurred speech. It is important to remember that the vertebral artery feeds the brainstem, inner ear, cerebellum and visual cortex. In some individuals with BPPV, they will give a minimally positive Vertebral Artery Test when their head is pitched back towards the offending ear. This, however, is usually transient and will clear after a few seconds. If it does not clear, then the clinician should be conservative in proceeding with a Hallpike Maneuver, particularly if the patient manifests a number of the indicators. A positive Vertebral Artery Test should be reported to the attending physician.

Care should also be consider in patients with cervical stenosis, severe kyphoscoliosis, limited cervical range of motion, Paget's disease, ankylosing spondylitis, low back dysfunction, spinal cord injuries Down syndrome, severe rheumatoid arthritis, cervical radiculopathies and morbid obesity. Patients who are obese may be difficult for a single examiner to fully support throughout the maneuver, so additional assistance may be required. For patients with physical limitations, special tilting examination tables may allow the safe performance of the Dix-Hallpike maneuver.

After the diagnostic has been established, the clinician can initiate the treatment of the condition. For PSC, the Epley repositioning maneuver guarantees a 92,6% rate of success (in our study 76 patients from 82 were stabilized after the repositioning maneuver – Fig. 6).

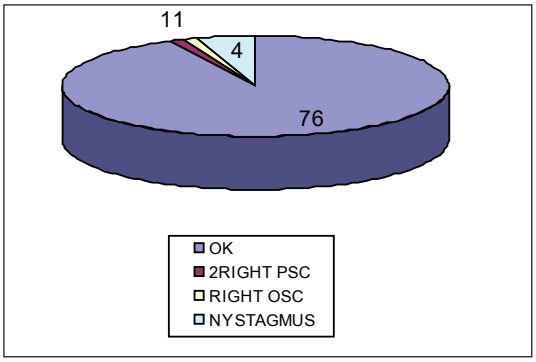

FIGURE 6. *Status at control examination*

CONCLUSIONS

The diagnostic of posterior canal BPPV is based on clinical observation of the cardinal indicators and does not require further paraclinical investigations. An accurate diagnosis contributes at a faster treatment (in our study we treated the posterior canal BPPV patients with Epley repositioning maneuver). Therefore it can be decreased he inappropriate use of ancillary tests such as radiographic imaging, vestibular and audiometric tests in order to promote the use of effective repositioning maneuver for treatment. However, if there is a concern that another less benign cause of vertigo may be present, other tests may be required. Audiometric and vestibular functioning testing are required when the diagnosis of a vertiginous or dizziness syndrome is unclear, when the patient remains symptomatic following treatment or when multiple concurrent peripheral vestibular disorders are suspected. Radiographic imaging (CT, MRI) should be reserved for patients who present a clinical history compatible with BPPV but also have additional neurological symptoms.

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